

FNAL/BNL long baseline study

- Milind Diwan 5/5/2006
- Lunch time discussion.

April 5, 2006

This letter is being sent to you as a follow-up to the Long Baseline Workshop held at Fermilab on March 6-7. This mailing list is composed of those who attended the study and signed up to receive further information or have subsequently expressed interest in the study. Since the kick off meeting we have redrafted the goals of the study. We have inserted a time scale which we judge to be achievable. The goal is described in the attached document. You can anticipate that within days you will get a further document in which Milind Diwan and Gina Rameika have attempted to parse the study goals into a set of work packages. We would like to hear from people who are prepared to do some work on these issues. Especially we would be very happy to hear from people new to these studies.

However, as you might expect we do have some likely suspects in mind and Gina and Milind will be contacting people to help. Finally, we will also be recruiting an Organising/Advisory Committee to help us guide this study. We look forward to seeing progress on this study and would welcome your suggestions for additions, adjustments and approach.

With Best Regards,

Sally & Mont

Sally Dawson, Chair, Physics Department, Brookhaven National Laboratory.

Hugh Montgomery, Associate Director, Fermi National Accelerator Laboratory

http://www.fnal.gov/directorate/DirReviews/Neutrino_Wrkshp.html

http://www.fnal.gov/directorate/DirReviews/Neutrino_Wrkshp.html

FUTURE_LONG_BASELINE_LIST@fnal.gov

To get on the list send email to
rameika@fnal.gov

U.S. Long Baseline Neutrino Experiment Study

April 3, 2006

Preamble:

The Fermilab Proton Driver (FPD) Study conducted in 2004/05 concluded that Neutrino Oscillation physics provides the main motivation for the FPD, and that the physics case is strong. In addition, the Fermilab 8 GeV linac beam could support other physics experiments in parallel with an upgraded NuMI-based neutrino program. The study results were presented to the Fermilab PAC in the 2005 Aspen meeting, and were well received. However, the PAC expressed interest in the possibility of a further generation of neutrino oscillation experiments at a FPD (beyond NOvA) but anchored by the NuMI facility.

Brookhaven National Laboratory has considered in some detail a very long baseline neutrino oscillations (VLBNO) concept using an on-axis, wide band beam but with a very large detector at a longer distance. This beam could originate from either Fermilab or BNL. This approach requires a large underground detector presumably located at the NSF's planned DUSEL facility, which would also have potential for other frontier physics in addition to neutrino oscillation physics.

While these two approaches have a common goal of understanding neutrino masses and mixings, they are clearly different. We would like to have a thorough study and exploration of the differences and potential of the two approaches. To that end we have drafted a charge for a joint Fermilab/BNL study, the results of which could form the basis for a national program in neutrino physics. This charge follows an initial short workshop which laid out some of the issues:

http://www.fnal.gov/directorate/DirReviews/Neutrino_Wrkshp.html

Timescale:

The United States neutrino community is heavily engaged in operation and analysis of its existing program. On the other hand there are active discussions within advisory bodies and the agencies with a view to setting directions for future facilities inside the next year.

It would be desirable to see results of this **U.S. Long Baseline Neutrino Experiment Study** before October 2006, with a preliminary report by July 15, 2006.

It would be desirable to see results of this **U.S. Long Baseline Neutrino Experiment Study** before October 2006, with a preliminary report by July 15, 2006.

U.S. Long Baseline Neutrino Experiment Study

Compare the neutrino oscillation physics potential of:

1. A broad-band proposal using either an upgraded beam of around 1 MW from the current Fermilab accelerator complex or a future Fermilab Proton Driver neutrino beam aimed at a DUSEL-based detector. Compare these results with those previously obtained for a high intensity beam from BNL to DUSEL.
2. Off-Axis next generation options using a 1-2 MW neutrino beam from Fermilab and a liquid argon detector at either DUSEL or as a second detector for the Nova experiment.

Considerations of each should include:

- i) As a function of θ_{13} , the ability to establish a finite θ_{13} , determine the mass hierarchy, and search for CP violation and, for each measurement, the limiting systematic uncertainties.
- ii) The precision with which each of the oscillation parameters can be measured and the ability to therefore discriminate between neutrino mass models.
- iii) Experiment Design Concepts including:

- Optimum proton beam energy
- Optimum geometries
- Detector Technology
- Cost Guesstimate

workplan

- 1) Water Cherenkov detector simulation and background estimate. Chiaki Yanagisawa, Lot more needed ...
- 2) 10 pages from Henderson on detector design. (Bob Wilson ?)
- 3) 10 pages from Homestake on detector design. (This is getting ready...)

workplan 2

- 4) Liquid Argon detector: resolution and background simulations and size optimization. (Bonnie Fleming)
- 5) Liquid argon detector: study of depth versus threshold and feasibility issues. (Bonnie Fleming)
- 6) Surface detector rates.

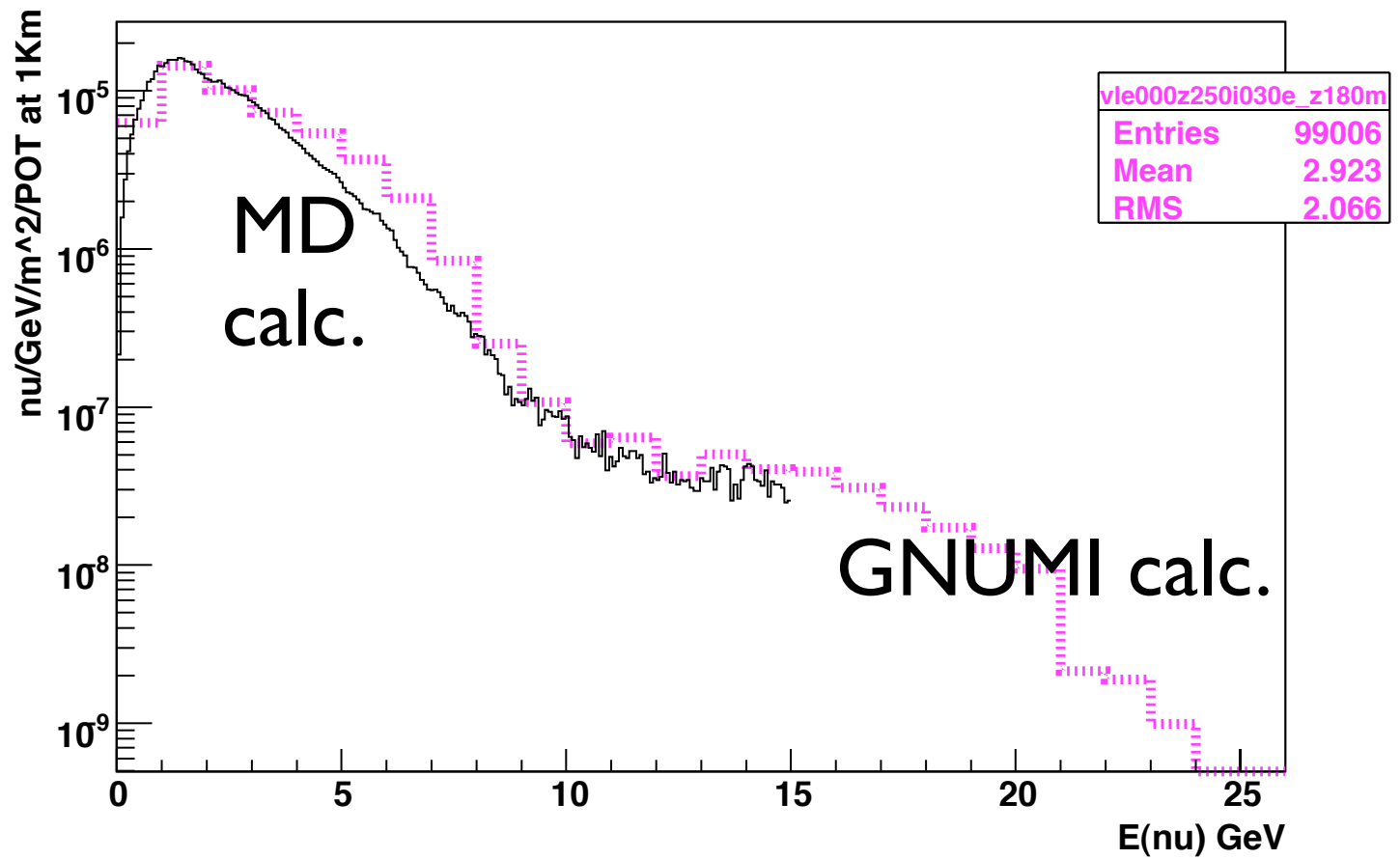
Surface Rates

- Search For Muon-Neutrino ---> Electron-Neutrino Oscillations.
B. Blumenfeld et al. 1989.
Published in Phys.Rev.Lett.62:2237-2240,1989.
- BNL-E776 (was on surface). Proportional drift tubes with concrete absorber. How many X_0 ?
- BNL-776 had cosmic background for muon neutrino back of 17 events. Measured with out-of-time triggers.
- Won Yong: scaling from 17 \Rightarrow NoVA should have 6000 background/year. (signal \sim 1200/yr).
- Raw rate in NovA is 1.6 MHz. Need calculation for NOvA-II

workplan 3

- 7) beam work:
 - a) How many protons at what E with existing complex at FNAL (Bob Zwaska)
 - b) How many protons at what E with PD.
 - c) How to shoot a beam to DUSEL ?
Target technical issues ? (Dixon)
 - d) Beam simulation and proton energy and spectrum optimization. (Bishai)

BNL, 28 GeV, 250 kA, Z=180m, R=2m,



M. Bishai/B.Viren

workplan 4

- 8) Sensitivity calculations:
 - a) Way-off-axis sensitivity (we need event rates for Way off axis)
 - b) wide band beam sensitivity (Patrick Huber, Marfatia, Diwan, getting done)
 - c) Study of possible new physics (is there a generic description ?) (short review ?)

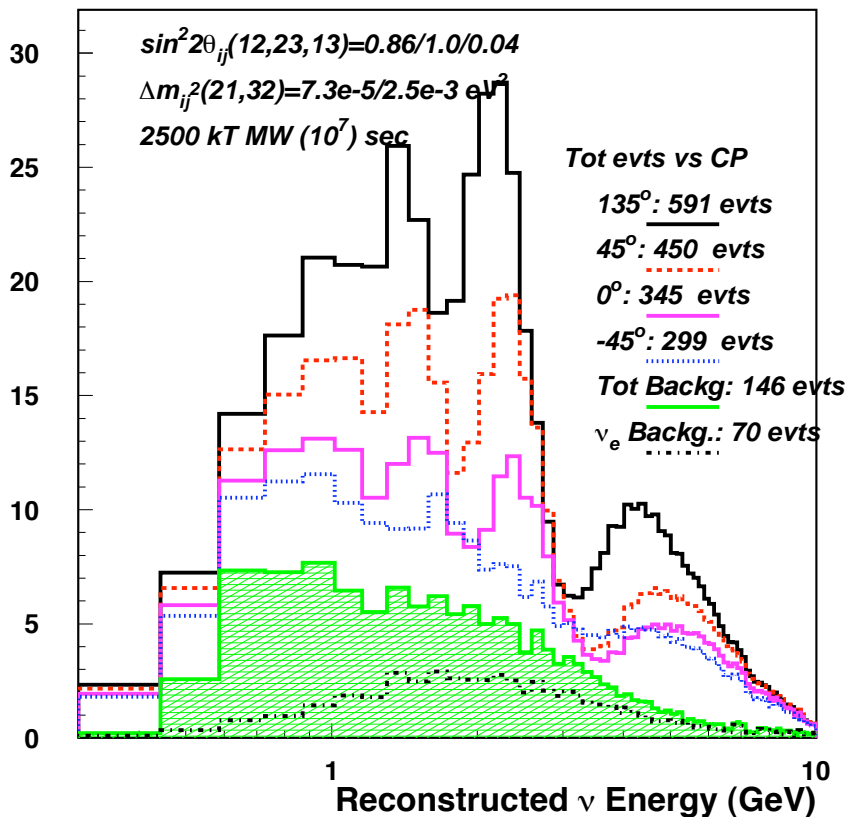
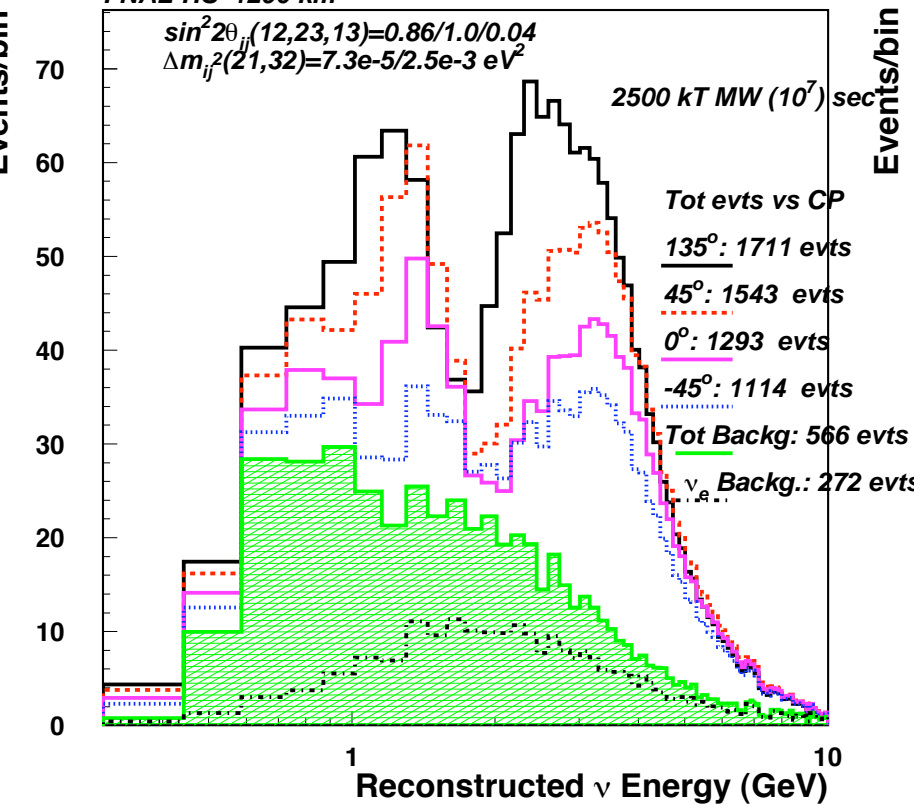
new plots

BNL-HS 254 km

ν_e APPEARANCE

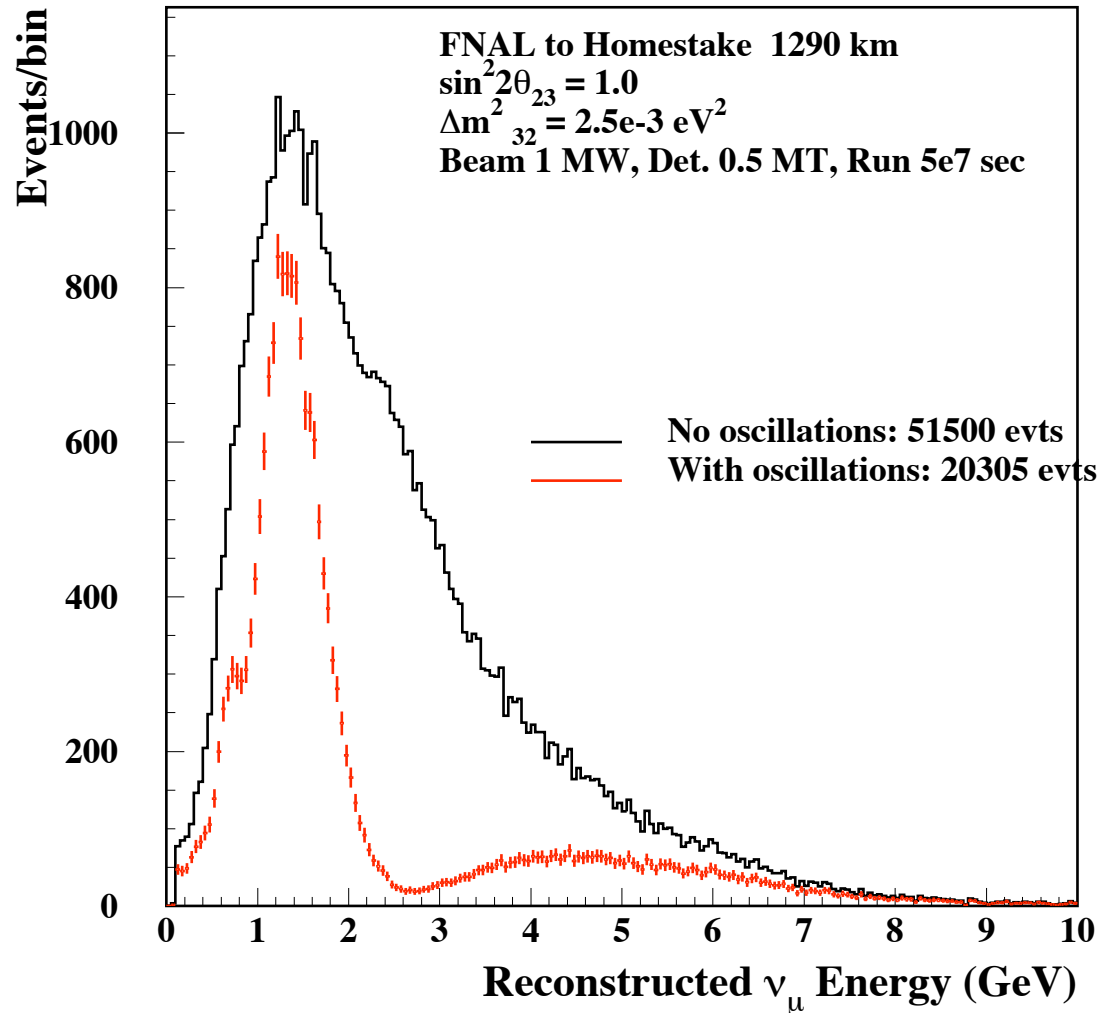
ν_e APPEARANCE

FNAL-HS 1290 km



some new physics ideas

ν_μ disappearance



- If beam can be made stiffer more ν_τ above 3.5 GeV
- The maximum dip at ~ 2.5 GeV is affected by any new phase differences between ν_μ and ν_τ (sterile?)

More physics ideas.

Need names

- Tau rates as a function of proton energy.
- Can we see tau's made at threshold in Water Cherenkov/ Liquid Argon ?
- Matter effects in disappearance for new physics (admixture of sterile, etc.)